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14. ABSTRACT

An acoustical assessment was performed on the 303IS transmission monitoring at Osan AB in May 2012. It was determined that personnel performing transmission monitoring duties were exposed to hazardous noise. Exposures at certain workstations were over the adjusted 12-hour exposure limit. Recommendations include enrolling personnel in the hearing conservation program, installing electronic filtering, use of noise cancellation headphones, and further investigation to determine root causes of hazardous noise levels.

15. SUBJECT TERMS

Noise, acoustical assessment, noise cancellation, octave band, hazardous noise

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a. REPORT	b. ABSTRACT	c. THIS PAGE			Mr. Andrew T. Wells
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DEPARTMENT OF THE AIR FORCE
USAF SCHOOL OF AEROSPACE MEDICINE (AFMC)
WRIGHT-PATTERSON AFB OH

7 May 2013

MEMORANDUM FOR 51 AMDS/SGPB
ATTN: MAJ JUNG LEE
UNIT 2060
APO AP 96278

FROM: USAFSAM/OEC
2510 Fifth Street
Wright-Patterson AFB, OH 45433

SUBJECT: Consultative Letter, AFRL-SA-WP-CL-2013-0009, Acoustical Evaluation of Transmission Monitoring at the 303rd Intelligence Squadron, Osan AB, ROK

1. INTRODUCTION:

a. *Purpose*: On 21-25 May 2012, the United States Air Force School of Aerospace Medicine, Consultative Services Division (USAFSAM/OEC) and USAFSAM Detachment 3 (DET 3-USAFSAM/CD), at the request of 51 AMDS/SGPB, conducted an acoustical evaluation of transmission monitoring at various workstations within the 303 IS/DOA. This assessment was accomplished to help determine worker audiogram requirements in accordance with AFOSH Standard 48-20, *Occupational Noise and Hearing Conservation Program*. Assessment data were collected for two separate AFSCs—1N2X1C, Communication Signals Intelligence Analyst, and 1N3X1, Cryptologic Language Analyst—at five different workstations. Data were also collected in three different ambient locations within the area of the facility where transmission monitoring occurs. This consultative letter provides the results of the evaluation and recommends appropriate engineering controls.

b. *Survey Personnel*:

(1) Chief, Occupational Health Services, DET 3-USAFSAM/CD
(2) Flight Chief, Consultation Division, DET 3-USAFSAM/CD
(3) Industrial Hygiene Consultant, USAFSAM/OECM
(4) Senior Noise Engineer, USAFSAM/OECC

c. *Personnel Contacted*:

(1) 303 IS/DO-1
(2) Superintendent, Current Operations, 303 IS/DOA

d. *Equipment*:

(1) Norsonic Real Time Analyzer, Type RTA 840, SN 18701
(2) B&K Head and Torso Simulator, Type 4128C, SN 2425802
(3) B&K Sound Level Calibrator, Type 4231, SN 2422533

2. METHODOLOGY:

a. USAFSAM personnel were not permitted to enter the room where transmission monitoring occurs due to compartmentalized security clearance requirements. Coordination prior to the assessment was accomplished to allow USAFSAM's equipment into the 303 IS facility. Due to this limitation, SMSgt Brown and MSgt Yi of the 303 IS were trained to operate the equipment and store the results of each assessment (see Attachment).

b. Sound pressure level (SPL) data were collected using a Brüel & Kjær Head and Torso Simulator (HATS) Type 4128C connected to a Norsonic Real-Time Analyzer (RTA) Nor-840. The RTA was set to slow response. The HATS and RTA were set up at a workstation used to monitor transmissions. A headphone from the 303 IS was placed on the head of the HATS to simulate the exposure to a workstation operator monitoring transmissions. The transmission signal was relayed to the HATS and the real operator simultaneously. If the operator adjusted the listening volume, the HATS would experience the same change. The RTA measured the 1/3 octave bands, equivalent overall SPLs for the given time of exposure, and the equivalent overall A-weighted SPL for the given time of exposure. This process was repeated at five different workstations: MB02, TA03, 212, 214, and 229.

c. SPLs using the HATS and RTA were also collected at three separate areas within the room where transmission monitoring occurs. These areas were identified as Conv, DGIF, and S&W by 303 IS personnel during the survey. The measurements were used to help determine if elevated background noise levels have an effect on listening volume inside the operators' headsets. During these measurements, the HATS system did not have a headphone attached.

d. Assessment data from workstation MB02 were collected while personnel with an AFSC of 1N2X1C performed monitoring duties. Assessment data from workstations TA03, 212, 214, and 229 were collected while personnel with an AFSC of 1N3X1performed their duties.

e. Due to the typical 12-hour work shifts in this facility, the adjusted exposure limit is 83 dBA time-weighted average, in accordance with paragraph 3.1.2. of AFOSH Standard 48-20.

3. RESULTS:

a. Listed in Table 1 is the overall average SPL for each sampling event at each workstation, as well as employee, AFSC, and whether noise cancellation was in use during the sampling event. Also listed in Table 1 is the overall SPL for each of the three ambient areas that were measured.

b. Measured SPLs at workstation 214 were consistently well below the 12-hour exposure limit, while measured levels at workstation 212 were consistently well above the 12-hour exposure limit. At workstation MB02, two of the seven total sampling events exceeded the 12-hour exposure limit, and at workstation TA03 two of three exceeded the 12-hour exposure limit.

c. Measured ambient SPLs in the facility were consistent at the three locations tested and were not hazardous; however, interference from background noise may cause operators to increase signal levels to overcome interference from background noise.

d. Hazardous noise levels were observed for 1N2X1C and 1N3X1 AFSCs while performing transmission monitoring duties.

Table 1. Measurement Summary

Employee	Workstation	AFSC	Average Sound Pressure Level (dBA)	Noise Cancellation (On, Off, N/A)
Johnston	MB02	1N2X1C	80.9	N/A
Johnston	MB02	1N2X1C	**85.3**	N/A
Rapoza	MB02	1N2X1C	75.8	N/A
Rapoza	MB02	1N2X1C	**87.7**	N/A
York	MB02	1N2X1C	71.9	N/A
Unnamed Operator #1	MB02	1N2X1C	80.6	N/A
Ashford	MB02	1N2X1C	80.2	N/A
Burns	TA03	1N3X1	**85.7**	N/A
Burns	TA03	1N3X1	77.8	N/A
Unnamed Operator #2	TA03	1N3X1	**86.7**	N/A
Jacobson	229	1N3X1	78.5	On
Jacobson	229	1N3X1	82.9	Off
Bergmann	214	1N3X1	64	On
Bergmann	214	1N3X1	72.2	Off
Andrews	212	1N3X1	**88.9**	Off
Andrews	212	1N3X1	**96.8**	**On**
N/A	Ambient, Conv	N/A	70.4	N/A
N/A	Ambient, DGIF	N/A	69.7	N/A
N/A	Ambient, S&W	N/A	70.1	N/A

4. DISCUSSION: **All current and future 303 IS personnel should be trained about the risk of hearing loss and their ability to reduce their own exposures** by avoiding headset volume settings louder than necessary to accomplish the mission.

5. RECOMMENDATIONS:

a. Based on the results and the observed variability in overall SPLs at the different workstations, **USAFSAM/OEC recommends that all personnel, regardless of AFSC, who conduct transmission monitoring at this 303 IS facility should be enrolled in the hearing conservation program and receive audiograms.** Paragraph 2.15.4. of AFOSH Standard 48-20 states that Public Health will "enroll personnel identified by supervisors as occupationally exposed to hazardous noise (by BE survey and recommended by OHWG) into a testing program that includes pre-placement, periodic (at least annually), and termination audiograms."

b. **Install and use electronic filtering**. For certain operations, it may be possible to filter the incoming signals electronically to reduce SPLs inside a headset. This would be particularly helpful while performing duties where the incoming transmission has a very narrow range of audible frequencies of interest. For example, if an incoming transmission signal has an audible frequency range of 500 Hz – 2.5 kHz, electronic filtering would remove any signals that fall outside this range. This may also reduce distractions and help the workers focus on what they are trying to monitor.

c. **Evaluate the workstations where hazardous SPLs were measured to identify sources contributing to elevated noise levels**. Workstation 212 should be the first priority. The operator was the same for both measurements at this workstation, so operator technique should be considered, as well as the process performed and equipment specific to this workstation.

d. **The use of noise canceling equipment does not appear to have a significant impact on the reduction of SPLs inside the headphones**. The use of this equipment should be based on operational requirements, as well as individual user preference; however, its availability to all personnel is recommended.

6. CONCLUSION: **Request a follow-up assessment after the installation of engineering controls or implementation of administrative controls is complete**. The assessment would determine the overall effectiveness of the controls to reduce the SPL below the maximum allowed for continuous noise.

7. We greatly appreciated the assistance of the 303 IS in accomplishing this assessment. If you have any further questions regarding this report, please contact Mr. Andrew Wells at DSN 798-3306 or andrew.wells@us.af.mil. Please direct any questions or comments regarding Industrial Hygiene Consultative support to Lt Col Sonntag at DSN 798-3328 or david.sonntag@us.af.mil. To improve our services, please complete and return the critique provided with this report.

JON E. BLACK, Maj, USAF, BSC
Chief, Bioenvironmental Engineering Consulting Branch

Attachment:
1/3 Octave Band Noise Data

Attachment
1/3 Octave Band Noise Data, 303 IS/DOA

Position	MB02
Name	Johnston
Duration(H:MM)	1:22
Headset Mfg	Sennheiser
Noise Cancellation	N/A

Frequency (Hz)	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	
Measured Leq	57.2	60.7	64.5	62.4	63.5	63.3	61.4	60.5	59.5	59.5	58.5	59.1	57.4	55.8	56.4	
Frequency (Hz)	500	630	800	1K	1.25	1.6	2K	2.5	3.15K	4K	5K	6.3K	8K	10K	12.5K	16K
Measured Leq	61.2	62.9	64.9	67.5	75.4	74.0	74.2	65.3	44.3	41.6	41.3	41.9	42.8	44.0	45.6	47.0

Linear	A-Weighted
80.8	80.9

Position	MB02
Name	Johnston
Duration(H:MM)	11:55
Headset Mfg	Sennheiser
Noise Cancellation	N/A

Frequency (Hz)	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	
Measured Leq	57	59.9	63.7	62.7	64.6	64	61.5	59.7	58.9	59.3	58.1	60.1	61.4	63.4	64.1	
Frequency (Hz)	500	630	800	1K	1.25	1.6	2K	2.5	3.15K	4K	5K	6.3K	8K	10K	12.5K	16K
Measured Leq	65	66.6	68.2	70.6	74.9	75.6	80	78.2	68.5	50.4	42.7	42.6	43	44	45.6	47

Linear	A-Weighted
84.6	85.3

Position	MB02
Name	Rapoza
Duration(H:MM)	1:59
Headset Mfg:	Sennheiser
Noise Cancellation:	N/A

Frequency (Hz)	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	
Measured Leq	60.4	61.5	63.3	63.8	65.8	66.1	65.4	64.7	64.6	61.6	59.2	58.1	57.5	57.6	58.7	
Frequency (Hz)	500	630	800	1K	1.25	1.6	2K	2.5	3.15K	4K	5K	6.3K	8K	10K	12.5K	16K
Measured Leq	59	58.7	59.2	60.5	62.9	64.7	69	70.1	63.5	58.1	52.5	48.9	47.1	47.6	46.1	47.6

Linear	A-Weighted
77.6	75.8

Position	MB02
Name	Rapoza
Duration(H:MM)	10:50
Headset Mfg:	Sennheiser
Noise Cancellation:	N/A

Frequency (Hz)	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	
Measured Leq	58.4	60.1	62.8	62.9	64.9	64.7	63.1	60.1	60.1	59.3	59.6	58.3	59.6	58.3	61.2	
Frequency (Hz)	500	630	800	1K	1.25	1.6	2K	2.5	3.15K	4K	5K	6.3K	8K	10K	12.5K	16K
Measured Leq	72.9	73	73.7	75.8	80.3	77.6	79.5	80.4	74.8	57.6	52.3	49	43.2	44.1	45.6	47.0

Linear	A-Weighted
87.3	87.7

Position	MB02
Name	York
Duration(H:MM)	5:00
Headset Mfg	Sennheiser
Noise Cancellation	N/A

Frequency (Hz)	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	
Measured Leq	58	60	62.7	62.8	64.8	64.8	63.1	59.9	60.4	59.8	59.7	57.7	57.9	60	59.6	
Frequency (Hz)	500	630	800	1K	1.25	1.6	2K	2.5	3.15K	4K	5K	6.3K	8K	10K	12.5K	16K
Measured Leq	59.1	58	61.2	61.6	60.1	62	65.8	62.5	56.6	41.6	41.3	42	42.7	43.8	45.5	47.1

Linear	A-Weighted
75.2	71.9

Position	TA03
Name	Burns
Duration(H:MM)	4:58
Headset Mfg	Sennheiser
Noise Cancellation	N/A

Frequency (Hz)	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	
Measured Leq	64.2	69.2	62	62.8	60.5	64.7	61.7	60.3	58.9	59.2	57.3	57.4	57.6	59.3	63.8	
Frequency (Hz)	500	630	800	1K	1.25	1.6	2K	2.5	3.15K	4K	5K	6.3K	8K	10K	12.5K	16K
Measured Leq	61.4	62	66.1	69.3	68.5	71.1	78.5	78.2	80.5	60.4	43.9	42.4	43	44.2	45.6	47.1

Linear	A-Weighted
84.9	85.7

Position	TA03
Name	Burns
Duration(H:MM)	5:02
Headset Mfg	Sennheiser
Noise Cancellation	N/A

Frequency (Hz)	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	
Measured Leq	64.4	68.4	63.2	64.1	64.3	68.6	71.8	73.4	72.4	69.7	67.4	66.9	66.7	62.4	59.8	
Frequency (Hz)	500	630	800	1K	1.25	1.6	2K	2.5	3.15K	4K	5K	6.3K	8K	10K	12.5K	16K
Measured Leq	59.7	59.3	60.1	61.4	62.9	65.5	70.2	72.3	68.7	54.9	43.4	42.2	43	44.2	45.6	47.1

Linear	A-Weighted
81.7	77.8

Position	Conv
Name	N/A
Duration(H:MM)	2:16
Headset Mfg	None
Noise Cancellation	N/A

Frequency (Hz)	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	
Measured Leq	68.6	68.6	63	64.5	64.5	66.6	62.1	59.3	58.6	58.3	56.5	56.3	55.9	56	57.8	
Frequency (Hz)	500	630	800	1K	1.25	1.6	2K	2.5	3.15K	4K	5K	6.3K	8K	10K	12.5K	16K
Measured Leq	60.3	59.7	57.1	55.2	54.8	57.2	59.6	52.1	61.3	59	54.5	53.8	55.3	56.8	55	52.6

Linear	A-Weighted
75.6	70.4

Position	229
Name	Jacobson
Duration(H:MM)	0:15
Headset Mfg	Bose
Noise Cancellation	On

Frequency (Hz)	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	
Measured Leq	58.6	58.6	54.1	54.3	54.7	54.5	53.9	54.6	55.1	57.3	62.8	60.6	58.4	59.2	65.8	
Frequency (Hz)	500	630	800	1K	1.25	1.6	2K	2.5	3.15K	4K	5K	6.3K	8K	10K	12.5K	16K
Measured Leq	62.4	64.3	58.7	58.8	61.2	68.2	71.6	72.5	69.6	54	44.1	42.1	42.7	43.8	45.5	47.1

Linear	A-Weighted
78.3	78.5

Position	229
Name	Jacobson
Duration(H:MM)	0:18
Headset Mfg	Bose
Noise Cancellation	Off

Frequency (Hz)	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	
Measured Leq	61.8	64.7	62.1	64.1	65.7	66.2	65.6	65.5	63.4	63.8	61.9	60.3	60.7	60.1	66.8	
Frequency (Hz)	500	630	800	1K	1.25	1.6	2K	2.5	3.15K	4K	5K	6.3K	8K	10K	12.5K	16K
Measured Leq	66	70	69.2	67.7	66.9	71.5	74.3	76.6	75.5	61.8	54	44.7	42.9	43.9	45.5	47

Linear	A-Weighted
82.8	82.9

Position	214
Name	Bergmann
Duration(H:MM)	0:19
Headset Mfg	Bose
Noise Cancellation	On

Frequency (Hz)	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	
Measured Leq	64	67.8	68.1	68.2	69.3	62.4	58.4	54.3	51.1	50	45.6	46.8	47.2	46	47.9	
Frequency (Hz)	500	630	800	1K	1.25	1.6	2K	2.5	3.15K	4K	5K	6.3K	8K	10K	12.5K	16K
Measured Leq	49.8	49.1	47.1	47	48.3	52.8	56.6	56.7	53.9	49.3	51	42.2	42.9	44	45.6	47.2

Linear	A-Weighted
75	64

Position	214
Name	Bergmann
Duration(H:MM)	0:21
Headset Mfg	Bose
Noise Cancellation	Off

Frequency (Hz)	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	
Measured Leq	61.9	64.3	63.4	64.9	67.5	64	62.5	61.2	61.2	63.5	62.8	66.3	62.6	56.6	57.6	
Frequency (Hz)	500	630	800	1K	1.25	1.6	2K	2.5	3.15K	4K	5K	6.3K	8K	10K	12.5K	16K
Measured Leq	59.5	59.5	57.7	55.7	58	62	64	63.4	61.3	60.4	61	46.3	42.9	43.9	45.5	47.1

Linear	A-Weighted
76.5	72.2

Position	212
Name	Andrews
Duration(H:MM)	0:24
Headset Mfg	Bose
Noise Cancellation	Off

Frequency (Hz)	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	
Measured Leq	59.8	65.1	62	64.6	69.8	66.7	63.4	62.8	61.2	65	64.4	66.4	66.3	66.7	68.1	
Frequency (Hz)	500	630	800	1K	1.25	1.6	2K	2.5	3.15K	4K	5K	6.3K	8K	10K	12.5K	16K
Measured Leq	70.3	72.5	73.9	74	73.9	76.5	80.9	82.9	81.6	68.1	55	44.3	43.4	44.7	45.6	47.1

Linear	A-Weighted
88.2	88.9

Position	212
Name	Andrews
Duration(H:MM)	0:27
Headset Mfg	Bose
Noise Cancellation	On

Frequency (Hz)	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	
Measured Leq	62.6	69.3	67.6	68.3	71.3	66	64.3	67.5	68.4	69.3	70.8	72.1	73.2	74.3	75.2	
Frequency (Hz)	500	630	800	1K	1.25	1.6	2K	2.5	3.15K	4K	5K	6.3K	8K	10K	12.5K	16K
Measured Leq	76.3	75.7	74.5	77	79.9	85.6	90.3	91.1	88.2	75.5	71.8	57.3	49.2	52.4	47.4	47

Linear	A-Weighted
95.9	96.8

Position	DGIF
Name	N/A
Duration(H:MM)	0:27
Headset Mfg	N/A
Noise Cancellation	N/A

Frequency (Hz)	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	
Measured Leq	60.1	63.6	60.4	62.3	65.1	66.2	64.2	62.7	60.3	60	57.5	58.4	57.5	55.3	55.9	
Frequency (Hz)	500	630	800	1K	1.25	1.6	2K	2.5	3.15K	4K	5K	6.3K	8K	10K	12.5K	16K
Measured Leq	56.8	58.1	56	57.6	55	56.1	59.6	62.2	61.4	57.5	54	49.5	48	48.2	46.7	47.4

Linear	A-Weighted
74.7	69.7

Position	S&W
Name	N/A
Duration(H:MM)	2:22
Headset Mfg	N/A
Noise Cancellation	N/A

Frequency (Hz)	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	
Measured Leq	57.7	64.6	63.3	64.8	64.3	64.1	65.5	64.5	56.7	57.3	57.1	57.4	56	55.2	57.3	
Frequency (Hz)	500	630	800	1K	1.25	1.6	2K	2.5	3.15K	4K	5K	6.3K	8K	10K	12.5K	16K
Measured Leq	57.8	59.1	57.3	57.8	56	58.3	59.4	62.4	61.3	57.4	54.1	50.5	47.6	48.1	46.8	47.6

Linear	A-Weighted
74.9	70.1

Position	TA03
Name	Unnamed Operator #2
Duration(H:MM)	5:42
Headset Mfg	Sennheiser
Noise Cancellation	N/A

Frequency (Hz)	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	
Measured Leq	64.9	68.7	61.7	63.8	62	65.3	60.7	59.5	58.4	59	59.9	66	73.7	74.2	74.3	
Frequency (Hz)	500	630	800	1K	1.25	1.6	2K	2.5	3.15K	4K	5K	6.3K	8K	10K	12.5K	16K
Measured Leq	73.4	73.1	74.4	73.5	74.8	75.8	78.5	78.8	75.8	73.5	71.4	62.6	56.2	55.6	49.7	47.1

Linear	A-Weighted
86.8	86.7

Position	MB02
Name	Unnamed Operator #1
Duration(H:MM)	6:13
Headset Mfg	Sennheiser
Noise Cancellation	N/A

Frequency (Hz)	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	
Measured Leq	56.4	59.3	63	61.9	64.4	64	60.9	59.1	57.4	58.9	56.1	56	53.6	55.6	59.9	
Frequency (Hz)	500	630	800	1K	1.25	1.6	2K	2.5	3.15K	4K	5K	6.3K	8K	10K	12.5K	16K
Measured Leq	66.5	69.5	68.4	67.7	68.1	70.5	72.9	75.3	61.9	45.1	41.6	42	42.8	43.8	45.5	47

Linear	A-Weighted
80.6	80.6

Position	MB02
Name	Ashford
Duration(H:MM)	2:18
Headset Mfg	Sennheiser
Noise Cancellation	N/A

Frequency (Hz)	16	20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	
Measured Leq	56.7	59.5	63	62.4	65	64.1	60.8	59.4	57.9	58.4	56.3	56.4	54.9	56.9	61.1	
Frequency (Hz)	500	630	800	1K	1.25	1.6	2K	2.5	3.15K	4K	5K	6.3K	8K	10K	12.5K	16K
Measured Leq	66.8	68.4	67.9	66	68.4	70.4	71.3	74.1	59.7	47.2	41.7	42.1	42.8	43.8	45.5	47

Linear	A-Weighted
80.2	80.2